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FRANKLIN SUMNER EARLE

Carlos E. Chardon

(With Plate 27)

Professor Franklin Sumner Earle, the recognized American authority on sugar-cane technology, and one of the "oldtimers" in American mycological science, passed away after an unexpected and sudden illness at his home in Herradura, Cuba, on January 31, 1929.

He was born in Dwight, Grundy County, Illinois, on September 4, 1856, son of Parker and Melanie (Tracy) Earle. During his early youth he attended, from time to time, the University of Illinois, but received no degree. A number of years later, after he had established a reputation for himself in the fields of botany and mycology, the Alabama Polytechnic Institute bestowed on him an honorary M.S. degree.

In 1892 he entered active experimental work as superintendent of one of the branches of the Mississippi Experiment Station, but his taste for purely mycological work, which was the distinctive feature of his early life, led to his appointment, in 1895, as assistant pathologist, in charge of mycological herbarium, U. S. Department of Agriculture. A year later, he again returned to the South as Biologist and Horticulturist of the Alabama Experiment Station, and it was here that Professor Earle came into close personal touch with the eminent mycologist George F. Atkinson. During 1901–04 he was in charge of the mycological collections at the New York Botanical Garden and intensified in the study of fungi. Being himself a member of the old school, he ventured to cover too wide a field in taxonomy. Thus, while specializing

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on the Agaricales on one hand he also tried to cover such widely different groups as the tropical species of *Meliola*, the Hypocreales, the Xylariaceae, and all the groups of the Fungi Imperfecti. Nevertheless, many of his new species still hold true after having challenged the criticism of a number of subsequent students.

In 1904, Earle initiated his fruitful association with the tropics by accepting the directorship of the Estación Agronómica at Santiago de las Vegas, Cuba. A group of distinguished men of science joined with him and substantial work in practically all lines of tropical agriculture was initiated under his leadership. It was very unfortunate for Cuban agriculture that the station failed to receive the full support of the authorities and the director and his associates had to resign two years later.

For several years after, he continued in Cuba, serving as consulting agriculturist to the Cuban-American Sugar Co. and as President of the Cuba Fruit Exchange. During these years, he became thoroughly familiar with sugar cane problems. He became also engaged in various private enterprises, especially fruit-growing, but with varying success.

In 1918, the U. S. Department of Agriculture appointed him Specialist in sugar-cane culture and commissioned him to visit Porto Rico with the purpose of studying a very severe disease which was threatening to destroy the sugar industry of the island. It was Earle's leadership and perfect grasp of the situation which in a few years satisfactorily solved the control of sugar-cane mosaic. It was his famous immunity experiment at Santa Rita in 1919 in which the Uba cane proved its immunity to mosaic, and the logical study which followed, of the vast problem of cane varieties, that is responsible for the varietal revolution which during the following ten years increased Porto Rico's sugar production from 406,000 tons to 742,000 tons, with no material increase in acreage.

It was early during this period that the writer had the privilege of becoming associated with Professor Earle, at the Insular Experiment Station at Río Piedras. His tireless industry and firm grasp of the subject of sugar-cane varieties, together with his extreme modesty and fine gentleness with his co-workers, excited the admiration and recognition of all with whom he became

associated. He became a true research leader and built around himself at the Station a group of young men who were to become prominent in the sugar-cane world as sugar-cane technologists. This group of Earle's students continued true to him up to his last breath and it is with the greatest sentiment of woe and sorrow that they heard of his unexpected death.

In 1921 he again left government work and was consulting agriculturist for Central Aguirre, on the south coast of Porto Rico, and two years later with the General Sugar in Cuba. He became in 1925 associated with the Tropical Plant Research Foundation until a few months before his death.

His work in Cuba was most fruitful, although he was very often misunderstood in his recommendations. His variety work continued with the greatest intensity and the varietal collection at his Herradura farm was the most complete in the island.

During the last years of his life he worked intensively on the sugar-cane problems of Cuba, especially on cane varieties, which was his favorite subject for study since his visit to Porto Rico. The available data that he compiled, from both Cuba and Porto Rico, was amazingly large and he started writing what was to be considered as his masterpiece, his last work "Sugar Cane," which appeared a few days before his death. This excellent treatise will stand out for many years to come as the standard classic on that subject.

He was member of the American Association for the Advancement of Science, the Torrey Botanical Club, the Botanical Society of America (President in 1906), and for many years associate editor of MYCOLOGIA.

Professor Earle is survived by Mrs. Esther J. Skehan Earle, and by two daughters: Melanie Tracy (Mrs. William L. Keiser) and Ruth Esther (Mrs. David Sturrock).

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SPECIES OF CERCOSPORA ON TRIFOLIUM, MEDICAGO, AND MELILOTUS[1]

James G. Horsfall

(With 3 Text Figures)

Recently while engaged in a study of certain meadow crop fungi, the writer encountered difficulty in assigning specific names to members of the genus *Cercospora*, occurring on legumes. This fact invited a critical examination of the organisms on various suscepts and a review of the literature to determine the status of the names which have been applied.

The work has resolved itself almost automatically into two divisions: a study of the fungi in the fresh condition on the different plants and an examination of herbarium material and literature. Since fresh specimens lend themselves to experimental comparison, the discussion of this phase will be considered first.

Examination of Fresh Material

The method which was used may be outlined briefly as follows. Fungi of the genus *Cercospora* were collected on as many of the members of *Trifolium*, *Medicago*, and *Melilotus* as possible in the field. They were brought into the laboratory where 100 conidia were measured from a water mount and a few of the typical ones were sketched with a camera lucida. Cultures were made from single conidia. A few leaves were boiled in KOH, dehydrated, and mounted permanently in balsam for future study of the conidiophores. The symptomatology was carefully described for each suscept and compared with others.

The results of this study led the writer to conclude that the fungus occurring on *Trifolium agrarium* L., *T. hybridum* L., *T.*

[1] Also presented to the Faculty of the Graduate School of Cornell University, February, 1929, as a minor thesis in partial fulfillment of the requirements for the Degree of Doctor of Philosophy.

Acknowledgment. The work was prosecuted under the helpful direction of Dr. H. M. Fitzpatrick to whom the writer desires to express appreciation. Dr. Charles Chupp also rendered valuable assistance during the investigation. Mr. W. R. Fisher made the photographs.

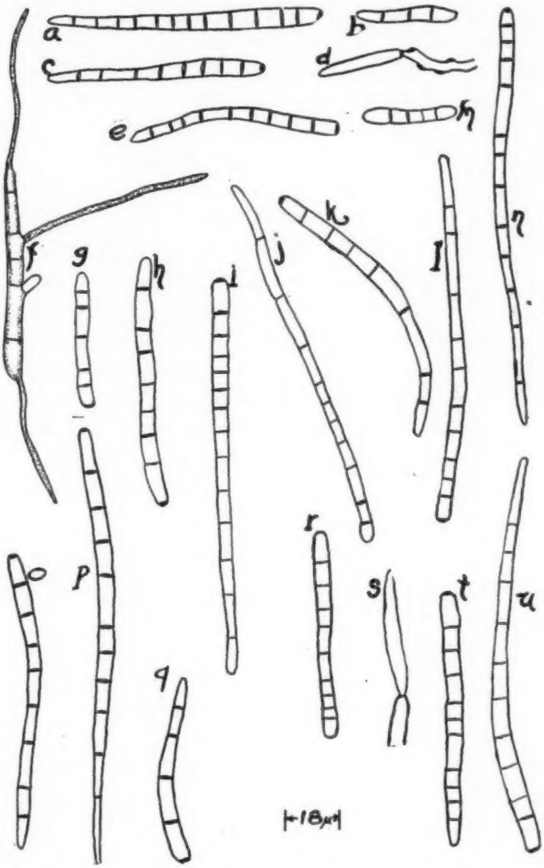

FIG. 1. Showing typical conidia of *Cercospora zebrina* Pass. from various plants. Sketched in the fresh condition with the aid of a camera lucida. *a*, *b*, *c*, and *e*, conidia; *d*, formation of a conidium terminally on conidiophore; *f*, germination of conidium. All from *Trifolium hybridum*. *g* and *h*, conidia from *Trifolium repens; i*, *j*, *k*, *l*, and *m*, conidia from *Medicago lupulina; n*, conidium from *Trifolium pratense; o*, *p*, and *q*, conidia from *Melilotus alba; r*, *t*, and *u*, conidia; *s*, formation of a conidium. All from *Trifolium agrarium*.

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pratense L., *T. repens* L., *Medicago lupulina* L., *M. sativa* L., and *Melilotus alba* Desr. constitutes one species. The evidence which indicates this is presented below.

Conidial characters. Spore measurements appear to mean but little in the genus, *Cercospora*. For example the conidia and conidiophores grow much longer when the fungus fruits under conditions of high humidity as opposed to conditions of drought. Welles (**5**) showed that the fungus structures of *Cercospora* are larger when moisture is abundant. He says also, "It may be seen readily that the sizes of the fruiting structures, induced through artificial inoculation, vary greatly, depending upon the host." Back in 1892 Atkinson arrived at the same conclusions from observational evidence (**1**). He says (pp. 3–7), "The specific differences of the various hosts as well as the structural variations of their leaves, the differences in texture, thickness and the varying power which the different species possess through their vital processes to resist the growth of the parasite, all exert a powerful influence upon its form and characteristics." The results of the measurement of 100 conidia in the fresh condition in a water mount are summarized in the table.

SUMMARY OF THE MEASUREMENTS OF 100 CONIDIA OF CERCOSPORA ON VARIOUS LEGUMES

Suscept	Variation		Mean length μ
	Length μ	Width μ	
Trifolium agrarium	36.0–140.4	4.0–6.0	82.12±0.82
Trifolium hybridum	21.6–149.4	3.6–5.4	66.98±2.08
Trifolium pratense	37.8–140.4	3.6–5.4	82.71±1.91
Trifolium repens	27.0–120.6	1.8–6.2	63.86±1.50
Medicago lupulina	30.6–180.0	3.6–5.4	87.49±3.58
Melilotus alba	34.2–117.0	3.6–6.0	69.23±1.32

It appears very obvious from this table that the spore size, especially length, fluctuates within wide limits. All the lengths with a single exception fall within the variation recorded for *Trifolium hybridum*, 21.6–149.4 μ. One spore from *Medicago lupulina* was 180 μ long. The variation in width is less, being between 1.8 and 6.2 μ. This would be expected since the ratio between length and width is so large that a big fluctuation in

length would hardly be measurable in width even if the two varied directly. The variation of the means is so small that it has no value in specific separation. Since the fungi on the various plants are not readily separable on the basis of spore length, it seems hardly desirable to resort to the measurement of 100 conidia to differentiate them. Spore measurements therefore indicate that only one species is involved. The differences between the means may be due to the presence of "strains" of the fungus, but they may be explained as readily on the basis of environmental effects.

The conidia collected on all plants are hyaline, many-septate, and cylindrical to attenuate above. The camera lucida sketches reproduced in figure 1 show the marked similarity of the spores from different sources.

Conidiophore characters. The conidiophores vary in length like the conidia, being governed apparently by the same conditions. They are amphigenous, light brown in color, sparsely septate, and usually geniculate. In all cases continuous or non-geniculate conidiophores can be found, but a search invariably reveals septa and geniculations in some of the conidiophores. The conidiophores seem to become septate and geniculate with age. The latter character is dependent upon the number of spores which have been produced on each conidiophore. The conidiophores arise from a small stroma which in any case contains but few more cells than the basal cells of the conidiophores. Some typical conidiophores sketched with the aid of the camera lucida are illustrated in figure 2, but these are from herbarium material.

Cultural characters. Cultures from single conidia from all the suscepts listed in the table are remarkably alike under identical conditions. Only a small amount of aerial mycelium is produced. The submerged growth is dull greenish black grading outward to a dark ivy green or vetiver green (Ridgway (**4**)).

Symptomatological characters. The shape and color of the lesions on the various plants lend some support to the theory that the diseases on them are identical. The spots on red clover leaves illustrated in figure 3 and those on hop clover may be said to be typical since they present the striped aspect from which the specific name, *zebrina*, derives its name. They are linear and

fairly sharply delimited. Terminal lesions on leaflets are triangular, being limited on either side by veins from the midrib. The elongated spots on red clover are in contrast with the almost circular spots on sweet clover, but all intergrading conditions exist on the other plants. Lesions on sweet clover leaves may reach five millimeters in diameter. As a rule alfalfa leaves bear smaller spots of the same general shape, but in one case the linear

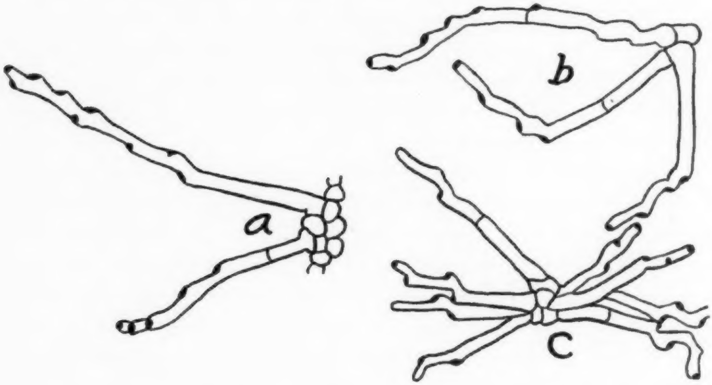

FIG. 2. Showing typical conidiophores of *Cercospora zebrina* Pass. on different plants. Scale same as in figure 1. *a*, from type material of *Cercospora zebrina* Pass. as distributed by Rabenhorst in Fungi Europaei, no. *2277*, on *Trifolium medium; b*, from material of *Cercospora Medicaginis* Ellis & Ev. as distributed by Ellis and Everhart in Fungi Columbiani, no. *2314*, on *Medicago sativa; c*, from material of *Cercospora Davisii* Ellis & Ev. as distributed by Ellis and Everhart in Fungi Columbiani, no. *1811*, on *Melilotus alba*.

spots were seen on secondary shoots developing under moist conditions. It appears then that atmospheric conditions and the type of tissue influence the shape of the spot. The spots on alsike clover, white clover, and yellow trefoil are intermediate between the circular ones on sweet clover and the linear ones on red clover. These spots are limited by veins to a large extent and are elongate but not sufficiently to form definitely linear spots as illustrated in figure 3.

Although the color of the lesions varies considerably, in general it is reddish or smoky brown. Color comparisons with

Ridgway gave the following for the various plants: chocolate or warm sepia on sweet clover; olive brown to wood brown on hop clover; deep brownish drab, light seal brown, and Hay's brown on yellow trefoil; bister, seal brown, bone brown and clove brown on red clover; Rood's brown and Prout's brown on alsike clover; burnt umber, warm sepia, chocolate, and sepia on white clover. The agreement of color symptoms on many of the suscepts suggests the identity of the diseases. Not only the shape but also the color of the spots on white clover are intermediate between those on sweet clover and red clover. Warm sepia and chocolate are common to the spots on white and sweet clover, while bister is common to the spots on white and red clovers. Light seal brown is common to the spots on yellow trefoil and red clover. The disease occurs on stems and petioles as somewhat shrunken lesions with colors similar to the lesions found on leaves.

EXAMINATION OF LITERATURE AND EXSICCATI

A search through the literature revealed six species of *Cercospora* described on members of the genera *Trifolium*, *Medicago*, and *Melilotus*. The original descriptions of all species were obtained and compared with each other. Except for *C. Meliloti* there appeared to be no essential differences between them.

Type material of all the species except *C. Meliloti* (Lasch) Oud. and *C. helvola* Sacc. has been available for study. However, Saccardo's drawings of the type of the latter have served for comparison. The writer is indebted to Dr. F. J. Seaver for permission to examine the types of *C. Davisii* Ellis & Ev. and *C. Medicaginis* Ellis & Ev. deposited in the Herbarium of the New York Botanical Garden and labelled in the handwriting of Ellis. Professor Irmscher of the Institut für Allgemeine Botanik und Botanischer Garten, Hamburgische Universität, sent for study a portion of the type of *Cercospora Stolziana* Magnus.

A critical examination of all the type materials gave precisely the same results obtained in studying field collections on the different plants. The conidia of all are hyaline, many-septate, quite variable in length, and obclavate or cylindrical. Conidiophores from all the specimens are of the same brown color, sparsely septate to continuous, sometimes geniculate, caespitose,

and borne on a limited stroma of the same color. *C. Medicaginis* and *C. zebrina* are stated to have continuous conidiophores, but the type material shows a few cross walls. *C. Stolziana* is said to differ from *C. helvola* and *C. zebrina* in the character of the spots, which are supposed to be somewhat blistered, but the type specimen sent to the writer bears spots which are identical in the dried condition with those collected on *T. repens* in New York as illustrated in figure 3. Welles (p. 216) says, "It has

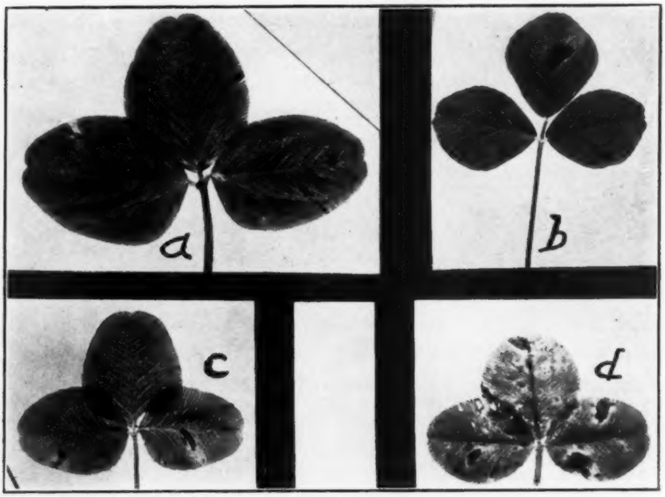

FIG. 3. Showing lesions caused by *Cercospora zebrina* Pass. on different plants. Note the striped or zebrine aspect. Natural size. *a*, on *Trifolium pratense*. Note petiole lesion. *b*, on *Medicago lupulina*. *c*, on *Trifolium hybridum*. *d*, on *Trifolium repens*.

been shown that the same organism through its stimulation brings about different reactions on plants which are not widely separated in their general make-up and relationship." It would appear then that a slight difference in the character of the spots even if it existed would be insufficient grounds for delimiting species. The spot really is a reaction on the part of the plant to the presence of the pathogene and is not an attribute of the fungus itself.

Cercospora Meliloti (Lasch) Oud. occupies a doubtful position.

Ellis has written on the packet of type material of *C. Davisii* in the Herbarium of the New York Botanical Garden that he sent some of it to Oudemans, who pronounced it different from his *C. Meliloti*. Oudemans' discussion of *C. Meliloti* is somewhat vague. He says (**3**) that the diseased leaves present blanched orbicular spots, oval to oblong and 2 to 4 millimeters in diameter. Black bodies resembling perithecia are scattered over these. He says superficial examination of these "quasi-perithecia" shows them to have a ragged opening, but a more careful examination shows that this is an opening in the epidermis of the leaf which allows the hyphae of the *Cercospora* to be protruded. Oudemans lists *Depazea Meliloti* Lasch as a synonym and bases *C. Meliloti* upon the specimen to which *D. Meliloti* had been applied. Saccardo (Sylloge Fungorum **10**: 362) placed *D. Meliloti* in *Septoria*. Lindau (**2**) states that he is in doubt as to the synonymy of *D. Meliloti* and *C. Meliloti*, but feels that it is possible "dass beide Pilze genetische in Zusammenhang ständen." It seems unwise in view of these facts and in the absence of type material to place *C. Meliloti* definitely in this scheme. It does appear from the description to be different from the other fungi on species of the genera in question.

Since all the evidence at hand indicates that only one fungus occurs on species of *Trifolium*, *Medicago*, and *Melilotus* except for the possible exception of *C. Meliloti*, all the names are cast into synonymy. *Cercospora zebrina* Pass., being the oldest name applied, must be used to denote this fungus.

CERCOSPORA ZEBRINA Pass. Hedwigia **16**: 124. 1877.

Cercospora helvola Sacc. Fungi Ital. *pl. 667*. 1881.

Cercospora Davisii Ellis & Ev. Proc. Acad. Nat. Sci. Phila. **43**: 89. 1891.

Cercospora Medicaginis Ellis & Ev. Proc. Acad. Nat. Sci. Phila. **43**: 91. 1891.

Cercospora Stolziana Magnus, Flora Tirol **3**: 558. 1905.

Spots amphigenous, dark brown, suborbicular to linear on leaves sometimes limited by veins; conidiophores amphigenous, light brown, erect, caespitose to scattered on a limited stroma, geniculate or shouldered, continuous, then sparsely septate, 20–80 $\times$ 3–5 μ; conidia hyaline, oblong-cylindrical to attenuate above, becoming multiseptate, 21.6–180.0 $\times$ 1.8–6.2 μ.

Habitat: On leaves, stems, and petioles of *Medicago arabica*, *M. maculata*, *M. hispida*, *M. lupulina*, *M. sativa*, *Melilotus alba*, *Trifolium agrarium*, *T. alpestre*, *T. hybridum*, *T. incarnatum*, *T. medium*, *T. pratense*, and *T. repens*.

Material examined under names listed:

Cercospora Davisii Ellis & Ev., *type*, Herb. N. Y. Bot. Gard. and Fungi Columbiani no. *1811*, on *Melilotus alba*.

Cercospora helvola Sacc., *type*, a drawing.

Cercospora Medicaginis Ellis & Ev., *type*, Herb. N. Y. Bot. Gard. and Fungi Columbiani no. *2314*, on *Medicago sativa;* Dearness as identified by Ellis, Herb. N. Y. Bot. Gard., and Fungi Columbiani no. *3209*, on *M. lupulina*.

Cercospora Stolziana Magnus, *type*, Herb. Hamburgische Universität, on *Trifolium repens*.

Cercospora zebrina Pass., *type*, Fungi Europaei no. *2277*, on *Trifolium medium;* Fungi Columbiani no. *461*, on *T. agrarium*, and no. *4709*, on *T. pratense;* Fungi Saxonici no. *1497*, on *T. medium;* Fungi Wisconsinenses no. *145*, on *T. repens;* Herb. Dept. Pl. Path. Cornell University no. *5843*, on *T. agrarium*, no. *17013*, on *T. hybridum*, no. *17052*, on *T. repens*, no. *17309*, on *T. pratense*, no. *17051*, on *Medicago lupulina*, no. *17446*, on *M. sativa*, no. *17447*, on *Melilotus alba;* Herb. James G. Horsfall no. *318* and *319*, on *Medicago hispida*.

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BOTRYOSPHAERIA AND PHYSALOSPORA IN THE HAWAIIAN ISLANDS

Neil E. Stevens[1] and C. L. Shear

(With 1 Text Figure)

The collection of Hawaiian fungi, of which the material discussed in this paper forms a part, was made by the writers during the winter of 1927–1928. The work was financed chiefly by the United States Department of Agriculture; assistance was also given by the Pan Pacific Research Council. We were aided in our work in one way or another by representatives of every scientific institution in the Islands, indeed, by almost every botanist. It would be a pleasure to acknowledge the assistance thus rendered by mentioning each of these friends, but the list would be a long one and could be more conveniently obtained by referring to a list of the members of the Botanical Society of Hawaii. Several years will, of course, be needed for working up the large quantity of fungi collected, even though many specimens have been referred to various specialists. It consequently seems wise to publish parts of the work as completed and to summarize with a final list.

The present paper discusses the two genera *Botryosphaeria* and *Physalospora*, which were worked up first because they are being actively studied in other parts of the United States. This material, while limited, has interest as bearing on the distribution and occurrence of fungi in the Islands. Fungi of these two genera are apparently not abundant. The numerous reports of *Diplodia* (under a variety of specific names) causing diseases of tropical hosts and our own interest in the group led the writers to devote especial attention to the occurrence of these fungi in the territory. In fact, one of us devoted most of his energies to searching for good material of these two genera on different hosts. The results were disappointing. In all we are able to list less than thirty collections with well developed, viable ascospores. A single day's

collecting in Florida or Georgia has sometimes yielded more good material of these two genera than the entire season in the Hawaiian Islands. As another indication of the relative scarcity of these genera it may be noted that F. L. Stevens, in his extensive collection of fungi in the Hawaiian Islands, reports the finding of only one species of *Sphaeropsis*, *S. Gouldiae*, and only one previous record of a *Diplodia*.

BOTRYOSPHAERIA RIBIS CHROMOGENA

The most abundant of any fungus belonging to this group was *Botryosphaeria Ribis chromogena* Shear, Stevens & Wilcox, of which we obtained nineteen collections with viable ascospores on the following hosts:

Acalypha sp.	*Pandanus odoratissimus* L. fil. (Fruits)
Aleurites moluccana Willd.	*Pipturus albidus* A. Gray
Eucalyptus sp.	*Psidium Guajava* L.
Hibiscus Sabdariffa L.	*Ricinus communis* L.
Hibiscus tiliaceus L.	*Schinus molle* L.
Leucaena glauca Benth.	*Schinus terebinthifolius* Raddi.
Mangifera indica L.	*Wikstroemia phillyreaefolia* A. Gray

From fifteen of these collections pycnospores have been produced in culture from single ascospores. Spore measurements are as follows: Ascospores: $14–28\ \mu \times 5–11\ \mu$; mostly $21–23\ \mu \times 8–9\ \mu$; Pycnospores: $16–27\ \mu \times 4–7\ \mu$; mostly $18–22\ \mu \times 5–6\ \mu$. These, as will be observed, correspond well with the measurements (Ascospores: $13–28\ \mu \times 4–12\ \mu$ and Pycnospores: $10–29\ \mu \times 4–9\ \mu$) for *Botryosphaeria Ribis* as found in the United States [(**5**) p. 101 and (**6**) p. 594]. Moreover, cultures of all of these nineteen collections produced, when grown on cornmeal in flasks, the pink coloration typical of the currant cane blight and, finally, five selected at random produced the typical cane blight when inoculated in currant plants at East Falls Church, Va., during the spring of 1928. There seems to be, then, no doubt of the identity of this Hawaiian material with the currant cane blight of the eastern United States.

The known range of this fungus has been greatly extended during the last five years. The disease of currant canes it causes has been known for more than thirty years. The fungus itself

was carefully described by Grossenbacher and Duggar (**2**) from currants in 1911. The first report of this fungus on a host other than currant was made by Stevens and Jenkins (**11**) in 1924. They reported it on horsechestnut and rose. Shortly afterwards, Fenner (**1**) found the fungus producing a rot of apples in several locations in the eastern United States. During 1924 (**8**) this fungus was found on numerous hosts, many of them native, in Georgia and Florida, and once in Cuba. The present record extends the range to include the Hawaiian Islands. The wide distribution of this fungus, together with the fact that it has been found on apples in the United States, lends further confirmation to the suggestion made in 1924 (**6**, p. 595) that the fungus described by Putterill (**4**) from South Africa on apple is identical with the *Botryosphaeria Ribis chromogena*.

PHYSALOSPORA FUSCA

This distinct species was obtained four times on the following hosts:

Acalypha sp.
Hibiscus tiliaceus L.
Lantana aculeata L.
Wikstroemia phillyreaefolia A. Gray

Although hitherto known only from a few collections in western Cuba (**9**) and found but four times in our Hawaiian collections, it seems reasonable to suspect that this fungus may in time be found generally distributed throughout the tropics. Ascospore measurements of Hawaiian material are 30–39 $\mu \times$ 13–19 μ; mostly 33–35 $\mu \times$ 14–15 μ; of the Cuban material hitherto described (**9**, p. 207) 29–37 $\mu \times$ 11–16 μ.

PHYSALOSPORA MALORUM ON OSTEOMELES

Perhaps the most interesting of all our finds in this group was a fungus which appears to be a form of *Physalospora malorum* (Peck) Shear. But three collections of this fungus were made, all on *Osteomeles anthyllidifolia* Lindl., in the Kona region of Hawaii. The host, called "Uulei" by the natives, is endemic, belongs to the Rosaceae, and is found as a small tree in the Kona region. The wood of this species is said to have been used by the Hawaiian

chiefs for the bows which they used in the sport of shooting the native Hawaiian rat.

The ascospores of this fungus—28–35 $\mu \times$ 10–15 μ; mostly 31–33 $\mu \times$ 10–12 μ—are well within the range of *Physalospora malorum* (**5**) as found in the eastern United States, 18–40 $\mu \times$ 6–16 μ. The pycnospores, however, measured 23–39 $\mu \times$ 10–14 μ; mostly

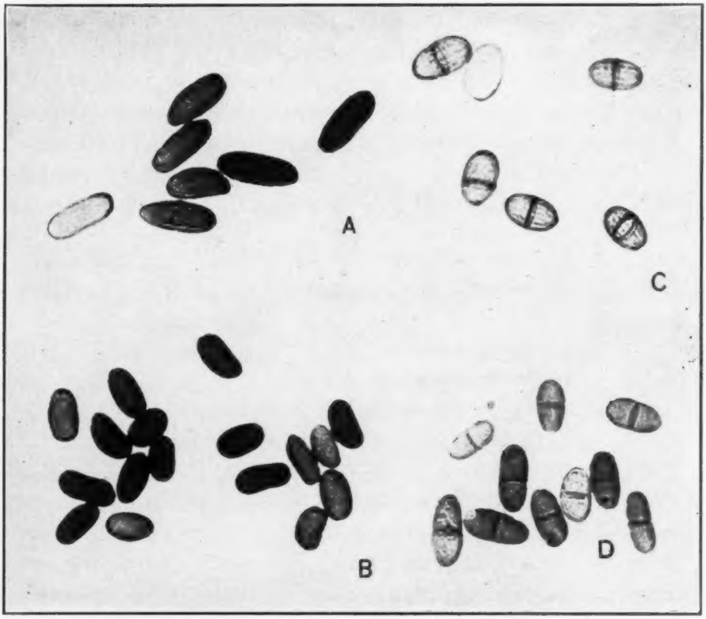

FIG. 1. *A*, *Physalospora malorum*, pycnospores produced in pure culture from ascospores. Spec. no. *1164*, on *Ostiomeles*, $\times$ 400; *B*, pycnospores of the type usually referred to as *D. natalensis*, produced in pure culture from pycnospores. Spec. no. *1196* on *Hibiscus*, $\times$ 400; *C*, pycnospores produced in pure culture from pycnospores on *Prosepus* sp. may be either a small form or *P. malorum* identical with *Sphaeropsis Gouldiae*, $\times$ 400; *D*, pycnospores produced in pure culture from pycnospores on *Prosopis* sp. This type seems to agree most closely with *S. malorum* of Berkeley and not with the form common in the eastern United States. $\times$ 400.

30–33 $\mu \times$ 11–12 μ. While most of the pycnospores of the fungus on Osteomeles fall within the range of pycnospores for this species (**10**), p. 336, 17–33 $\mu \times$ 7–15 μ, they are much above the mean in

length. Their general appearance, however, is identical with that of pycnospores of *Physalospora malorum* as commonly found in the eastern United States, uniformly brown in color and almost always one-celled. There appears, therefore, to be no sufficient reason at this time for considering this fungus distinct from *P. malorum*, especially in view of the fact that pycnospores of *P. malorum* are decidedly variable in size and some strains with unusually large pycnospores have been described even on apple (**12**).

PYCNIDIAL FORMS

It seems surprising to us that no ascospore material was obtained from which was developed the pycnidial form so often reported in the tropics and which is often called *Diplodia natalensis* or *Botryodiplodia Theobromae.* This pycnidial form itself seems to be rare in Hawaii. Only four collections, three on *Hibiscus tiliaceus* L. and one on *Panax* sp., were made which correspond to "*D. natalensis*" morphologically, and of these only No. 1148 on *Hibiscus* had the characteristic often associated with cultures of this species, that of being able to grow in culture at 36° C. (**9**, p. 215). The spore measurements of this material were: pycnospores produced in culture, 20–37 $\mu \times$ 10–17 μ; mostly 21–26 $\mu \times$ 12–14 μ.

Two other pycnidial forms were found and may be briefly described, although no specific names will be assigned. Three collections were made—one each on *Leucaena glauca*, *Nerium Oleander*, and *Prosopis* of a fungus, with brown one-celled pycnospores, size 17–23 $\mu \times$ 9–14 μ; mostly 18–21 $\mu \times$ 9–12 μ. This may, perhaps, be considered a small form of *P. malorum* and is possibly identical with *S. Gouldiae* Stevens and Plunkett (**7**, p. 136).

Two collections, one on *Gossypium* and one on *Prosopis*, have brown septate pycnospores with spore measurements as follows: 20–27 $\mu \times$ 9–12 μ; mostly 21–23 $\mu \times$ 10 μ. This more nearly resembles what we consider typical material of *P. malorum* of Berkeley, common in Europe and found in the northwestern part of the United States.

Distribution of Botryosphaeria and Physalospora in the Hawaiian Islands

As already noted, our collections are so scant as to indicate that fungi of these genera are not abundant in the territory of Hawaii. One important factor may be the lack of cut brush. Fungi of these genera fruit most abundantly on branches which have been cut while still living and left for a number of months. Such brush is abundant in the southeastern United States but relatively rare in the territory of Hawaii, partly because of a habit of neatness, which makes a yard man a conventional part of the equipment of every complete household.

The distribution of these fungi on the larger Islands suggests that the peculiar climatic conditions may not be favorable to their growth and spore production. In the "rain forest" of the Islands these fungi are rarely found. Indeed, in the "rain forest," fungi of any kind are rare. This seems to be true in other tropical countries. The drier portions where, except for irrigation, practically desert conditions exist, are also unfavorable to both these genera. The only places where they are even relatively abundant are the regions which are dry except for abundant tropical showers and the transition zones between the wet and dry portions, about where irrigation begins. An alternation of relatively short wet and dry periods is, of course, the normal condition in the southeastern United States, where we have collected these fungi so extensively and find them so abundant.

It will be noted that most of the specimens reported are on host plants which were introduced early by man and are now widely distributed in the Islands and especially in regions where the climatic conditions for the development of these fungi seem favorable. Of the native hosts the following are regarded as endemic by Hillebrand (**3**): *Pandanus*, *Pipturus*, *Osteomeles*, *Wikstroemia*. Of these *Pipturus* is frequently found associated with the introduced plants bearing these fungi. The specimens on *Wikstroemia* were found on the slopes of Manua Loa with none of the introduced hosts observed in the vicinity. The material on *Osteomeles* presents the most interesting case as it is an endemic host bearing a form of *Physalospora* not found on any

other host in the Islands. We might, perhaps, be justified in supposing this to be a native fungus.

In connection with the discussion of the distribution of these fungi on native hosts, it should be mentioned that the "Ohia lehua" of the natives, *Metrosideros polymorpha* Gaud., is the most generally distributed and abundant tree found on all the Islands in those regions where these fungi were chiefly found; but, notwithstanding a thorough search of this host, not a single specimen of any of the fungi discussed in this paper was found. It may be that cut branches of certain hosts furnish more favorable substrata for the development of these fungi than others and this may be a factor in determining the abundance and distribution of these fungi on native hosts. The behavior of these fungi in the eastern United States seems to indicate very little host preference as they have been found on a large number of woody hosts in the southern States. *Diaporthe* species are apparently competitors for the possession of cut or dying branches and species of this genus were much more abundant on the hosts mentioned than *Physalospora* and *Botryosphaeria*. This is also true to a considerable extent in southern Florida.

It will be noted that all the fungi mentioned in this paper are considered to be either identical with or very closely related to those already known from other parts of the world. In this connection, it should be remembered that a very large part of the flora of the Islands is made up of introduced plants, many of which are very widely distributed. It will, then, not be surprising if a very large number of the fungi found in the Hawaiian Islands prove to be of relatively recent introduction.

BUREAU OF PLANT INDUSTRY,
WASHINGTON, D. C.

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THE LONGEVITY OF MYXOMYCETE SPORES

Ernest C. Smith

(With Plate 28)

The longevity of myxomycete spores is a subject which has received little attention. One searches the literature in vain for definite and specific information as to the length of time such spores retain the power of germination. Lister simply states that, if kept dry, the spores retain their vitality for several years. While there is difficulty in securing germination of the spores of some species, whatever the age, workers find the mature spores of many species quite viable at the end of two or even three years. Data for the viability of spores of greater age are conspicuously lacking.

The writer of this article, in connection with other investigations, left some ten-year-old spores in a hanging drop culture and after five days noted with surprise that germination had taken place. This led to further investigation of the viability of spores of known ages from four to nearly thirty-two years. In every case germination was secured and in some cultures the percentage of viable spores was quite as great as in cultures where the spores were less than a year old. The elapsed time between wetting of the spores and the observed emergence of the swarm-cells was somewhat greater than with younger spores, but the following development was regular in all the species tested—loss of flagellum, cell division, sometimes repeated several times, fusion of myxamoebae and formation of small plasmodia.

The definite data on the germination of these aged spores are contained in the following table.

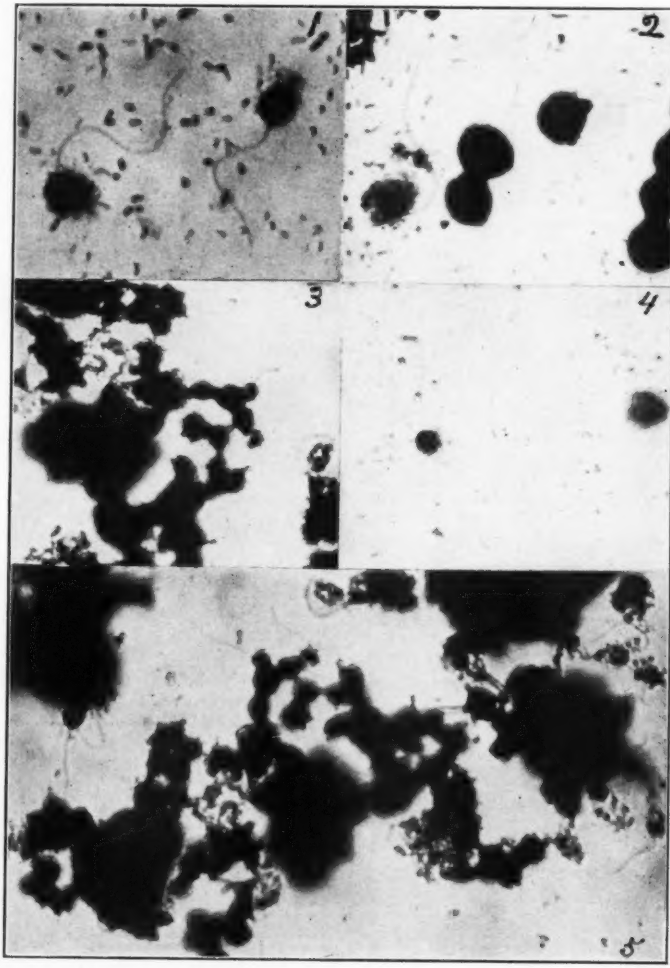
The elapsed time between the wetting of the spores and the observation of germination is not significant, as observations were sometimes twenty-four hours apart and in a few cases germination was well advanced when first observed. Some of these aged spores were received from Dr. Jahn in Germany; the oldest were collected in Michigan by Prof. B. O. Longyear of our Forestry department.

Within the limits of the investigation it is clear that the age of the spores is not a very important factor in germination. The spores of certain species, when less than a year old, show a very small percentage of germination, while those of other species

Species	Collected	Wetted	Germinated
Stemonitis flavogenita Jahn	July, 1924	March, 1929	18 hrs.
Fuligo septica (L.) Gmel.	July, 1923	March, 1929	3 das.
Reticularia Lycoperdon Bull.	June, 1919	March, 1929	30 hrs.
Lamproderma violaceum (Fries) Rost.	July, 1916	March, 1929	48 hrs.
Trichia favoginea (Batsch) Pers.	March, 1913	March, 1929	43 hrs.
Enteridium olivaceum Ehrenb.	Oct., 1912	April, 1929	54 hrs.
Badhamia utricularis (Bull.) Berk.	Oct., 1909	March, 1929	44 hrs.
Stemonitis ferruginea Ehrenb.	June, 1908	March, 1929	42 hrs.
Dictydiaethalium plumbeum (Schum.) Rost.	1907	March, 1929	66 hrs.
Badhamia panicea (Fries) Rost.	1906	March, 1929	68 hrs.
Trichia Botrytis Pers.	Oct., 1903	March, 1929	42 hrs.
Lepidoderma tigrinum (Schrad.) Rost.	Oct., 1903	March, 1929	52 hrs.
Physarum straminipes Lister	1903	April, 1929	72 hrs.
Trichia scabra Rost.	Aug., 1902	April, 1929	72 hrs.
Trichia lateritia Ler.	Nov., 1901	April, 1929	48 hrs.
Physarum cinereum (Batsch.) Pers.	May, 1900	March, 1929	40 hrs.
Didymium squamulosum Fries	June, 1899	April, 1929	72 hrs.
Fuligo septica (L.) Gmel.	June, 1899	April, 1929	72 hrs.
Diachaea leucopoda Rost.	June, 1899	April, 1929	46 hrs.
Hemitrichia clavata Rost.	July, 1897	April, 1929	66 hrs.
Stemonitis ferruginea Ehrenb.	June, 1897	April, 1929	48 hrs.

show very great variations in germination even when taken from sporangia collected at one time and place. These phenomena are repeated in the aged spores. One very evident cause of variation is difference in maturity of spores at time of collecting, a difference which in some cases clearly extends to different spores in the same sporangium. As all spores were cultured under identical conditions other causes for small percentage of germination in certain species may be in different optimum temperatures or pH values.

The investigation was limited by the material immediately at hand. Almost certainly such uniform results would not be reached with all species. Yet the fact that the species tested come from widely separated groups suggests that we are here dealing with a phenomenon which is not exceptional, but fairly general. At the least, we have an additional instance of the remarkable vitality and protective adaptability of the organisms



MYXOMYCETE SPORES

of this group which, during so large a part of their life cycle, consist of naked protoplasm. We see that this extraordinary vitality of the spores is in direct line with the power of the swarm-cells and young plasmodia to form cysts and of the older plasmodia to form sclerotia, resting stages with thick protecting walls, from which, under favorable circumstances, they return to their previous appearance and functions. The limits of these resting stages have never been precisely determined, though Jahn has done both extensive and intensive work on the age phenomena of sclerotia. The organisms of this group, by common consent not in the direct line of organic evolution, seem to have preserved primitive characteristics of adaptability and tenacity which make them a fascinating field for the study of the inherent qualities of protoplasm.

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EXPLANATION OF PLATE 28

Fig. 1. Swarm-cells from spores of *Reticularia Lycoperdon* collected in June, 1919, germinated in March, 1929. × 1000.

Fig. 2. Swarm-cells (one emerging from spore) from spores of *Dictydiaethalium plumbeum* collected in 1907, germinated in March, 1929. × 1000.

Fig. 3. Swarm-cells of *Lepidoderma tigrinum* emerging from spores collected in October, 1903, germinated in March, 1929. × 600.

Fig. 4. Swarm-cells and amoeba from spores of *Physarum cinereum* collected in 1900, germinated in March, 1929. × 1000.

Fig. 5. The field of which No. 3 is a portion.

These figures are microphotographs.

THE LARGE LEAF SPOT OF CHESTNUT AND OAK ASSOCIATED WITH MONOCHAETIA DESMAZIERII

George Grant Hedgcock

Arthur H. Graves[1] in 1912 described a leaf disease of chestnut and oak and ascribed it to *Monochaetia Desmazierii*. This disease is characterized by large, more or less circular, leaf spots with concentric zones of varying gray, yellow, and brown. These spots vary in size, but frequently attain the diameter of one inch. Graves reported the disease on *Castanea dentata* in Virginia, North Carolina, and Georgia, and on *Quercus borealis maxima* in North Carolina.

The writer has had this disease under observation since 1912 and finds that it occasionally causes considerable injury to the foliage of trees. The injury, however, usually occurs late in summer after the trees have made their growth, which no doubt greatly lessens the effect on the trees. *Monochaetia Desmazierii* is constantly present on the leaf spots caused by this disease, but its parasitism has never been proven.

In order to show the range of this disease and of *Monochaetia Desmazierii*, the states from which specimens have been collected are given, which are as follows:

On *Acer rubrum*[2] in Georgia, North Carolina, and Tennessee.

On *Castanea dentata* in Georgia, Indiana, North Carolina, Tennessee, and Virginia.

On *Hamamelis virginiana* in Georgia, Maryland, Tennessee, and Virginia.

On *Hicoria alba* in Tennessee.

On *H. glabra* in Maryland.

On *H. laciniosa* in North Carolina.

[1] Graves, A. H. The large leaf spot of chestnut and oak. Mycologia 4 170–174, pl. 69, fig. 1, 1912.

[2] The nomenclature used for trees is that of Geo. B. Sudworth in "Check List of the Forest Trees of the United States, their Names and Ranges," U. S. Dept. Agr. Miscellaneous Circular 92. March, 1927.

On *H. ovata* in Tennessee.

On *Quercus alba* in North Carolina and Tennessee.

On *Q. borealis maxima* in Georgia, North Carolina, Ohio, and Tennessee.

On *Q. coccinea* in Tennessee.

On *Q. marilandica* in Arkansas and Tennessee.

On *Q. montana* in Georgia, North Carolina, and Tennessee.

On *Q. myrtifolia* in Florida.

On *Q. rubra* in Florida, North Carolina, and Tennessee.

On *Q. stellata* in Arkansas, North Carolina, New Jersey, and Tennessee.

On *Q. velutina* in North Carolina, and Tennessee.

On *Q. virginiana geminata* in Florida.

On *Ulmus alata* in Georgia.

The disease as known by the writer ranges from Indiana to New Jersey and southward to Arkansas and Florida. It attacks eighteen species of trees of six different genera. It probably attacks other species of the same and of different genera over a larger area than is now reported.

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NEW AND NOTEWORTHY FUNGI—VI[1]

John Dearness

HYPHOMYCETES

Ramularia Chrysopsidis sp. nov.

Spots small and subcircular at first, becoming irregular, lacking definite border, above merely paler than surrounding surface, beneath marked by whitening due to the numerous fascicles of fertile hyphae but becoming brown as these disappear with age. Fertile hyphae hypophyllous, hyaline, narrow, 1 μ, fasciculate, base tuberculate. Conidia fugacious, 6–15 × 2 μ, continuous to 1-septate.

On living leaves of *Chrysopsis mariana;* Southold, N. Y.; Sept. 21, 1919. R. Latham: *3032.* (D. *4404.*)

Ramularia Grantii sp. nov.

Spots pallid, similar on both sides of the leaf but contrasts with surroundings stronger on the upper side, often dark brown in a portion of the border, 0.5–3 cm. long by 0.5 cm. wide, sometimes extending along a vein. Fertile hyphae hyaline, amphigenous but mostly hypophyllous, in small clusters, sometimes a single hypha, scattered over the spot and usually densely congregated along and near the vein, 18–30 × 3 μ. Conidia hyaline, oblong, rounded and often somewhat contracted towards the ends, long-catenate, 1-septate, 15–24 × 3–5 μ.

Parasitic on living leaves of *Angelica genuflexa;* Marysville, Wash.; June 1928. J. M. Grant: *7061.* (D. *6713.*)

The descriptions of *R. Archangelicae* Lindr. and *R. Angelicae* v. Höhn do not admit this species.

Ramularia Ivae Dearn. & Barth. sp. nov.

Spots mostly marginal, pale brown, spreading to the midrib and occasionally beyond it, boundary not definitely marked. Fertile hyphae amphigenous, mostly hypophyllous, densely fasciculate, hyaline, 6–15 × 2.5–3 μ, rising from a shallow tubercular base 10–45 μ thick and 0.1–1 mm. in diameter. Conidia hyaline, oblong, continuous, rarely 1-septate, 12–32 × 3.5–5 μ.

[1] Continued from Mycologia **20**: 246. 1928.

On living leaves of *Iva axillaris* Pursh; Lyman, Wyo.; Aug. 21, 1917. V. Simmons, J. R. Weir: *8976.* (D. *4585.*)

RAMULARIA MITELLAE Peck, var. **Heucherae** var. nov.

This form differs from the type in having smaller and more orbicular spots with a wide, dark brown margin and whitish center. The conidia are 10–19 × 2.5–3 μ.

On living leaves of *Heuchera glabra;* Mt. Rainier National Park, Wash.; alt. 7000 ft.; Sept. 1924. J. M. Grant: *6004.* (D. *5805.*)

Cercosporella Lilii sp. nov.

Spots diaphanous areas extending from the margin to the midrib, seldom crossing it but often occupying most of half of the leaf, marginless or having a brownish diffuse margin, distorting or curving the leaf towards the affected side. Fertile hyphae amphigenous, in very numerous short fascicles, 5–15 × 2.5–3 μ. Conidia hyaline, 2- to 5-septate, not strongly obclavate, densely enough congregated to give a white flocculent appearance to portions of the spot.

Parasitic, exhausting the leaf parenchyma, on *Lilium canadense;* Hudson Falls, N. Y.; July 1, 1919. S. H. Burnham: *322.* (D. *5975.*)

Coniosporium parasiticum sp. nov.

Conidia dark brown, obovate, apiculate, 8–12 × 4–6 μ, growing on obscure, subhyaline, prostrate, short, branching hyphae.

On green cotyledons of *Citrullus vulgaris;* Stirling, Ont.; May 21, 1927. Com.: Prof. J. E. Howitt. (D. *6325.*)

Quite different from *C. Fairmani* and *C. apiosporoides* both on Cucurbit hosts. This seems to be parasitic but it is not proved that it may not be secondary. Its gross appearance on the cotyledons is much like that of *Apiosporina Collinsii* on Juneberry leaves.

Cladosporium subsessile Ellis & Barth.

Parasitic and very common on leaves of *Populus tremuloides* along the river banks. Saskatoon, Sask.; June 1926. Prof. W. P. Fraser.

This species was published as *Cladosporium brevipes* Ellis & Barth. in Erythea **4**: 27. 1896; and distributed as No. *3288* in Ellis and Everhart's N. Am. Fungi. The name was later

emended as above on account of its preoccupation for a species on oak leaves,—N. Y. Rept. **40**: 64. 1894.

In the description in Erythea the authors state that the spots themselves are caused by insects from which it may be inferred that the fungus is secondary. In the Saskatoon material the spots are numerous, circular, 2–3 mm. in diameter and lacking visible evidence of the intervention of insects.

Stigmina Vitis Dearn. & Barth. sp. nov.

Spots irregular, 3–10 mm., becoming confluent, appearing at first on the lower side of the leaf, dull grayish brown, later developing on the upper side, dark brown. Fertile hyphae in thickly scattered fascicles on small tubercles about 35–60 μ in diameter and 30–40 μ high, hypophyllous. Conidia continuous to 3-septate, reaching 30 μ in length, formed of cells variable in size but mostly about $7–10 \times 7–9\ \mu$.

Parasitic on leaves of *Vitis Girdiana* Munson; Riverside, Cal.; Aug. 9, 1924. E. Bartholomew: *8886*. (D. *5659*.)

Septonema formiculum Dearn. & Barth. sp. nov.

Fertile hyphae very short, dark brown, 7 μ in thickness. Conidia black, shining, long barrel-shaped, $15–45 \times 12\ \mu$, 2–7 septate, catenate, as many as 6 or even more in a chain; chains branching.

Producing black patches, 1–3 cm. on decorticated branches of *Morus alba*. The numerous short spore chains resemble so many ants under the low power of the microscope.

Collected at Stockton, Kan.; June 13, 1923. E. Bartholomew: *8199*. (D. *5782*.)

Heterosporium laricinum sp. nov.

Fertile tufts grayish brown, amphigenous, consisting of 2 or 3 to 20 or more erect or ascending brown hyphae, septate, geniculate with up to 5 conidia-bearing knees, $20–225 \times 7–10\ \mu$. Conidia subhyaline to fuliginous brown, oblong-elliptic, asperate, uniseptate, $18–21 \times 6–8\ \mu$.

Common on hanging and fallen needles of *Larix occidentalis* Nutt.; Marcus, Wash.; Aug. 13, 1928. G. G. Hedgcock: *47183*. Another ample collection Sept. 21, 1928. G. G. H. *48469*. (D. *6812*.)

The most vigorous tufts were in clefts produced by an undeter-

mined *Melampsora*. *H. Laricis* Cooke & Massee has hyphae 15–18 μ thick and conidia 50–60 μ long.

Ophiotrichum Verbenae Dearn. & Barth. sp. nov.

Spots visible only on the lower side of the leaves grayish brown, bounded by the strong veinlets, 0.5 cm. wide. Fertile hyphae 1–3 mm. long, creeping, loosely branching in a compound radiate manner, pale brown, septate, nodulose, 4–5 μ thick. Conidia paler, continuous to 5-septate, sometimes shortly catenate, 12–35 × 3.5–6 μ, mostly between 21 and 28 μ long by 4.5 μ wide.

On living leaves of *Verbena urticaefolia;* Birmingham, Ala.; Oct. 4, 1924. E. Bartholomew: *8951.* (D. *5651.*)

CERCOSPORA CHENOPODII Fres. var. **micromacula** var. nov.

On *Chenopodium Boscianum;* Stockton, Kan.; Fungi Columb. No. *2210;* and on probably the same host at Seaford, Del.; C. R. Orton, L. O. Overholts: *8345.* (D. *5651.*)

This differs from the typical form as represented in European and American exsiccati in having whiter, more definitely red-bordered, smaller spots, 1–2.5 mm., looser and longer fertile hyphae up to 120 × 4.5 μ and shorter, often continuous or only up to 2-septate conidia, 30–45 × 6–7 μ.

Cercospora Cryptotaeniae sp. nov.

Spots scattered small, dark brown, angular, veinlet-bounded, 1–3 mm., similar on both sides of the leaf. Fertile hyphae hypophyllous, in numerous, small suberect tufts of 3–7 brownish units, 25–50 × 4–6 μ, continuous or 1 to 2 septate. Conidia subhyaline, narrowly obclavate, pluriseptate, 45–90 × 3 μ.

On living leaves of *Cryptotaenia canadensis;* Hudson Falls, N. Y.; July 13, 1919. S. H. Burnham: *400.* (D. *5988.*)

Cercospora Phaseoli Dearn. & Barth. sp. nov.

Spots scattered, numerous, dull reddish brown above, sooty gray beneath, subcircular, immarginate, 0.5–1 cm. Fertile hyphae chiefly hypophyllous, fasciculate, the longer ones torulose, 1–3 septate, brown, 10–60 × 3.5–6 μ. Conidia forming a tomentum-like layer on the lower side of the spot, dilutely colored, attenuate-obclavate, tip obtuse and usually more than half as thick as the base, nucleate, 1–6 septate, 10–150 μ mostly 45–85 × 3-6 μ.

On living leaves of *Phaseolus vulgaris;* Brownwood, Mo.; Oct. 3, 1923. E. Bartholomew: *8516.* (D. *5431.*)

Of four Cercosporae reported on this host and its allies this species seems nearest *C. olivacea*.

Cercospora umbrata Ellis & Holw. var. **maculata** var. nov.

This differs from the type in the spots being definitely maculate and the conidia larger, 30–66 × 3–4.5 μ.

Parasitic on leaves of *Bidens laevis;* London, Ont.; Sept. 13, 1923. Dearness: *5370.*

Helminthosporium lumbricoideum sp. nov.

Hyphae brown, long, up to 2 mm., branches few, diverging at various angles, septate, septa about 15 μ apart, wall 2–3 μ thick. Conidia brown, 10–16 septate, 130–150 μ long, 12–15 μ thick in the middle, evenly attenuated to 6–7 μ at both ends.

Producing a thick dark felt on dead stems of *Vaccinium* sp.; Mt. Baker, Wash.; July 1927. J. M. Grant: *6056.* (D. *6367.*)

Hyphae and conidia are different from those of *H. attenuatum* Cooke & Peck.

Dendryphium brunneum Dearn. & Barth. sp. nov.

Blotches seal-brown, subcircular or irregular, 0.5–5 cm. Hyphae brown, much branched, closely septate, 5–7 μ thick; wall 1.5 μ thick. Conidia pleurogenous, brown, oblong or ellipsoid, narrowing towards the ends, 8–30 × 5–8 μ, 1–6 septate, often nucleate between the septa which are from 4 to 8 μ apart, catenate, some of the chains are long and curving so as nearly to form a circle.

On bark of dead, firm branches of *Sorbus scopulina;* Jenny Lake, Wyo.; July 12, 1924. E. Bartholomew: *8788.* (D. *5712.*)

Stigmella Platani-racemosae Dearn. & Barth. sp. nov.

Beginning as small, scattered, sooty blotches on the lower side of the leaf and extending indefinitely; the upper side over the affected areas tardily becoming brown. The unit masses of short fertile hyphae and conidia dark, subglobose, 40–90 μ. Conidia dark brown, becoming phragmosporous and often muriform, globose to ovoid, 9–18 × 9–12 μ.

Parasitic on leaves of *Platanus racemosa;* Riverside, Cal.; July 9, 1924. E. Bartholomew: *8889.* (D. *5652.*) Related to *S. Platani* (Fuckel.) Sacc.

Stigmella Vernoniae Dearn. & Barth. sp. nov.

Covering the upper side of the leaves with a sooty layer resembling the usual appearance of *Fumago vagans*, numerous small

patches on the lower side. Spores black, globose, 20–30 μ in diameter, made up of cells 5–9 μ in diameter, on very short brownish, branched hyphae 3–4 μ across.

On living leaves of *Vernonia gigantea* (Walt.); Williamsville, Mo.; Sept. 28, 1923. E. Bartholomew: *8474*. (D. *5384*.)

Coniothecium Eriodictyonis Dearn. & Barth. sp. nov.

Sooty blotches occur on both sides of the leaf but more numerous and extensive on the lower side, small and circular at first, 2–3 mm. in diameter, becoming large and irregular, sometimes confluent, affected areas on the upper side finally become red brown. Hyphae 10–37 × 5–7 μ, septate, brown, single or fasciculate. Conidia brown, uneven or rough but not echinulate, muriform and sarciniform, sometimes phragmosporous, mostly of 4 to 8 cells in a mass becoming coalescent into more or less irregular, dictyosporous masses of 12 to 24 or more cells 5–10 μ in diameter.

On living leaves of *Eriodictyon tomentosum* Benth.; Corona, Cal.; Sept. 8, 1924. E. Bartholomew: *8934*. (D. *5657*.) Superficially this resembles both N. Am. Fungi *3491*, *Heterosporium Eucalypti* Ellis & Ev. var. *maculicolum* and Fungi Columb. *1171*, *Heterosporium californicum* Ellis & Ev. ined., which may have been parts of a collection of leaves of *Eriodictyon*.

Glutinium hystricinum sp. nov.

Synnema thickly scattered, black, cylindric, not globose at base, 0.5–0.9 mm. long, hard when dry. Conidia hyaline, elliptic or oblong-elliptic, grumous and nucleate, 20–27 × 9–12 μ, on rather stout, simple or branched conidiophores, 25–32 × 3–4 μ.

On dead branches of *Quercus Prinus;* Mattituck, N. Y.; Feb. 28, 1924. R. Latham: *1823*. (D: *5534*.)

Fusarium phacidioideum sp. nov.

Sporodochia phacidioid, nearly circular, somewhat cup-like, surrounded by the cuticle, 0.5–1.5 mm. wide, disk yellowish gray, becoming darker with age until nearly concolorous, scattered. Conidia hyaline, crescentic, acuminate-acute, curved to a semicircle, the outer end sometimes incurved, uniformly 3-septate, 45–75 μ long by 3.5–4 μ thick; conidiophores detach in fascicles, 15–20 μ long.

On dead branches of *Pseudotsuga taxifolia;* Stanley Park, Vancouver, B. C.; Aug. 24, 1924. J. S. Boyce: *1285*. (D. *5666*.)

Exosporium Betheli sp. nov.

Sporodochia minute tubercles, contiguous, seriate, producing black lines between the leaf-scales. Mature conidia dark brown, clavate, almost uniformly 8-celled, 35–51 × 6–8.5 μ exclusive of the hyaline, proximal cell or pedicel which is 15–16 × 5 μ.

On living branchlets of *Juniperus occidentalis* Hook.; Big Bear lake, Cal.; Aug. 2, 1920. Ellsworth Bethel. (D. *5565*.)

The late Professor E. Bethel made several collections of this species and remarked that he always found it associated with *Gymnosporangium inconspicuum* Kern apparently on the mycelium or incipient stage of the rust. Its spores are much larger than those of *E. deflectens* Karst., which are 14–20 × 5–6 μ. In some of the black lines there is a Mycosphaerella, hardly mature. The asci are 78–100 × 6.5–7.5 μ; ascospores not well defined, 1-septate and about 18–24 × 3.5–5 μ.

Exosporium rhoina Dearn. & Barth. sp. nov.

Pulvilli scattered, black, seated in the cortex with a broad flat base, 1.5–3 mm., raising the epidermis into large pustules and rupturing it in a crateriform manner, the flat or sometimes concave top about 1 mm. wide. Conidia brown, 3-celled, round at the top, the lowest cell narrowed to the base, 28–42 × 13–19 μ; fertile hyphae pale brown, short, simple or shortly branched, 6–8 μ thick.

On dead branches of *Rhus glabra;* Moscow, Ida.; June, 1917. C. H. Shattuck, J. R. Weir: *9212*. (D. *4584*.)

LONDON, ONTARIO,
CANADA

THE PRODUCTION OF NORMAL SPOROPHORES IN MONOSPOROUS CULTURES OF AGARICUS CAMPESTRIS

Edmund B. Lambert

(With 1 Text Figure)

Since 1918, when, Bensaude (1) first called attention to heterothalism in the *Agaricaceae*, the sex phenomenon in that group has been investigated in numerous species of several genera. This work has recently been summarized by Kniep (**5**). As far as the writer is aware there have been no investigations of this question

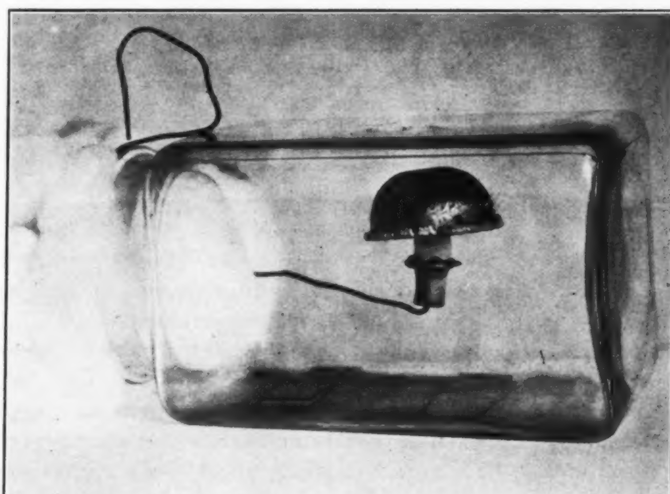

Fig. 1. Apparatus used to gather spores on glass microscope slides under aseptic conditions.

in the case of cultivated mushrooms. In the United States there are several distinct varieties of cultivated mushrooms some of which are probably not *Agaricus campestris* (**2**, 6). The variety *Agaricus campestris* which is most extensively cultivated has 2

spores on a basidium and is known to the trade as the "Snow White" variety. As the first step in the investigation of the sex phenomenon in this variety the writer has made monosporous cultures and has grown normal sporophores from them.

Spore prints were made under aseptic conditions. This was accomplished by a modification of the method used by Ferguson (**3**). The sporophores were selected when slightly expanded but before the veil had ruptured; they were submersed in a 1 to 1000 solution of bi-chloride of mercury for 3 minutes and dried off over a bunsen burner; they were then placed in a candy jar, which had been autoclaved, and arranged as shown in FIGURE 1. In these containers sporophores as a rule expanded, ruptured the veil and shot spores in a few days. The spores were then transferred, from the glass slides on which they were collected, in a loop of sterile distilled water to liquid agar, cooled to 45°C. A synthetic agar was used.

It was made up as follows:

Magnesium sulphate	0.5 grms.
Potassium acid phosphate (monobasic)	1.0 "
Sucrose	3.0 "
Maltose	1.0 "
Dextrose	1.0 "
Agar agar	12.0 "
Distilled water	1.0 liter

Although there was considerable difference in the percentage of germination of spores from different spore prints, as a rule germination was plentiful in this agar at room temperature (22°–25° C.).

Single spore cultures were made by the dilution culture method in petri dishes using the technique suggested by Keitt (**4**). Isolated spores which were just beginning to germinate were picked up in a block of agar and transferred to fresh petri dishes of sterile agar. The growth of the mycelium from the spore was watched at daily intervals. Further transfers were not made until the mycelium had grown out from the original block of agar. When making spawn by transferring these agar cultures to sterile manure, a higher percentage of successful transfers was obtained by placing the bottles of sterile manure in a moist chamber for a few days after the transfers were made.

Nine single spore cultures were made in this way and spawn

from them was placed four feet apart in standard shelf beds of composted horse manure. All possible matings were also made and planted in a similar way.

In all cases normal sporophores developed. The experiment was repeated 5 months later and again normal sporophores developed from single spore cultures. There is, of course, the possibility that viable spores of *Agaricus* were present naturally in the compost and germinated when approached by the mycelium running from the spawn. However, it seems highly improbable that the sporophores were produced by chance matings in the beds for three reasons: first, in all cases the sporophores appeared first immediately above the pieces of spawn; second, all of the sporophores were typical of the "Snow White" variety; and third, no mycelium of *Agaricus* appeared in several check beds which were not spawned. To the writer the evidence seems quite conclusive that this variety is capable of producing vigorous normal sporophores from single spores.

BUREAU OF PLANT INDUSTRY,
WASHINGTON, D. C.

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NOTES AND BRIEF ARTICLES

The new rust book by Dr. J. C. Arthur and his collaborators, which was announced in the March–April MYCOLOGIA, appeared during the summer. The work, which covers all phases of the rust question, consists of 446 pages of text profusely illustrated and 186 text figures, both drawings and half tones. While the work is not taxonomic, a brief discussion of this problem is incorporated. A list of families and genera is included and the points of departure from the system used in North American Flora emphasized. Some of the more recently proposed generic names such as *Dicaeoma* and *Nigredo* have been discarded in favor of the more commonly recognized names *Puccinia* and *Nigredo*. The book will doubtless be widely used by mycologists in every part of the world.

Proposed amendments to the "International Rules of Nomenclature," widely distributed by J. C. Arthur last March and printed in the May–June number of MYCOLOGIA (**21**: 172–174), have been revised and will appear in their final form in a recent number of *Science*.

Only two changes are advocated. The first proposal would make 1753 a uniform date for the beginning of priority, for which there appears to exist much favorable sentiment. The second proposal would make names applied to rusts under the genus *Uredo* equally valid with those given to the telial stage. This has the effect to recognize all names applied to the sporophytic stage of the rust, and in consequence conserves more names in current use than the rule as it now stands.

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